

## REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration for an allowance is requested in view of the amendments above and the remarks below.

### Rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1-5 and 21 under 35 U.S.C. § 102(b) as being unpatentable over Shibata (U.S. Patent No. 6,734,556). Applicants respectfully disagree.

The Examiner states that Shibata teaches an article formed by wire bonding a first chip to a second chip. The Examiner relies on Shibata (column 4, lines 62-64) to introduce a metallic wire material (i.e., gold wire), and Shibata (column 4, lines 57-60) to introduce a metallic interconnect made of copper metal within the substrate. The Examiner relies on Shibata, column 4, lines 18-20 to state that the alloying material is said to comprise alloying metal other than the metallic wire material. Applicants do not read Shibata as making this teaching or suggestion.

Shibata teaches bump electrodes of first and second semiconductor chips both made of a first metal such as Au, while joining with a portion made of an alloy layer of the first and second metal, where the second metal is made of a material that can melt at a lower temperature than the melting point of the first metal to be alloyed with it. Shibata, Abstract.

This is not the teaching of the present invention, which requires, *inter alia*, "said alloying metal comprising alloying metals *other than* said metallic wire material." Claim 1 (emphasis added).

The Examiner relies on a suggestion by Shibata to use a copper wiring made with a barrier layer provided on the Cu wiring, and an Au wiring provided on the barrier metal layer, where the low-melting point metal layer is made of an Au-Sn alloy on the Au wire. Shibata, col. 4, ll.54-62. However, in this manner, the alloying metals do indeed include a metal from the wire.

As depicted in several embodiments of Shibata, a joining layer must include the alloying metal from a wire. For example, in the embodiment represented by Fig. 6, an Au electrode bump 21 is bonded to a Sn layer 16, which includes an Au film 15 over a barrier metal layer 14. The underlying electrode terminal 12 may be any metal protected by the barrier metal layer 14. Similarly, as depicted in the embodiment of Fig. 7, wiring 18 made of Au is formed as connected to electrode 12 made of Al, etc., via the barrier metal layer 14. An Sn coating 11a can be formed at the joining portion on the Au wiring 18 and abutted against the bump electrode 21 of the second semiconductor chip. Shibata, col. 12, ll.13-20.

When discussing the use of copper wiring, Shibata states the following:

To join the chips through the wiring portions, in place of the Au wiring 18 shown in Fig. 7, an Al or Cu wiring may be formed in some cases. In such a case, the joining portion of, for example, an Al wiring, can be provided with the barrier metal layer, the Au layer, and the Sn coating as shown in Fig. 7 to thereby join the chips easily. In the case of a Cu wiring, on the other hand, as shown in Fig. 8, on a Cu wiring 31, only the joining portion can be provided with a barrier metal layer 32 made of Ti/W or Ni by plating and, thereon, with a Sn coating 34 to thereby be joined with the second semiconductor chip 2 having the bump electrode 21 made of Au as mentioned above. Shibata, col. 12, ll.27-38.

In this embodiment, the Al wire is provided with a barrier Au layer, which forms an alloy with the Sn coating. By using the Au barrier layer, the wiring interface is effectively an Au material, not the underlying Al material. Applicants respectfully submit that this is the

same as using an Au wire since it is only this portion of the Al wire (the Au barrier layer) that combines with the Sn layer. Using Au as a "barrier layer" over the Cu wire should not remove it from consideration as a portion of the wiring. Inasmuch as this Au layer is part of the wiring and an alloying metal, it falls outside the scope of claim 1.

Similarly, in a further embodiment, Shibata combines a Cu wire with a barrier layer and an Au wire on that barrier layer. Shibata, col. 4, ll.57-60. In this manner, the Cu wire is attached to, and protected by, the barrier layer, which is in contact with the Au wire, which ultimately forms a eutectic with the Au-Sn bond. Again, this teaching is outside the scope of claim 1.

Applicants respectfully submit that claim 1, as previously amended, is sufficiently narrow to overcome a 35 U.S.C. § 102 rejection of Shibata. It is submitted that the claims remain patentably distinct over this cited prior art.

It is respectfully submitted that the application remains in a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited.

Respectfully submitted,



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